

# Progress and Problems in Preventive Medicine

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Ether Day Address

1913

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BY  
MILTON J. ROSENAU, M.D.  
*Professor of Preventive Medicine  
and Hygiene*

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## PROGRESS AND PROBLEMS IN PREVENTIVE MEDICINE.\*

BY M. J. ROSENAU, M.D., BOSTON,

*Professor of Preventive Medicine and Hygiene, Harvard Medical School.*

THE Massachusetts General Hospital has long been a hospital of hospitals, a teacher of teachers, a physician to physicians. It has a proud heritage from the past that is also a heavy responsibility for the present. Its ideals have extended beyond the walls of the institution, for in addition to administering to the sick, it has taken an active part in the history of American medicine, and it has been a model that has been copied far and wide. Its many achievements on the side of science, its humanity as expressed in its social service work, and its long list of notable sons have placed it in the forefront of *Hôtels Dieu*.

We are here to celebrate the birthday of the chief among these achievements—the first public demonstration of surgical anesthesia. Three score and seven years ago John Collins Warren operated upon Gilbert Abbott under the deep sleep of ether administered by William Morton. We are again met to recall the deeds and the men conspicuously associated with the Massachusetts General Hospital; and to dedicate ourselves to the task of adding further drops of knowledge to the unceasing stream of blessings which continue to flow as a result of the event we celebrate anew today.

These blessings have been rich and varied, for they not alone made modern surgical practice possible, but they opened up fields of experimental biology in hitherto unsuspected and rewardful directions. It was about the time that this precious gift was given to suffering humanity that Darwin helped us throw away the crutches of traditional authority on which we limped, that Huxley clearly

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\* Address delivered at the Massachusetts General Hospital on Sixty-seventh Anniversary of Ether Day, Oct. 16, 1913.

defined man's place in nature, and Pasteur unraveled the secrets of fermentation and infection. These important conceptions and discoveries marked the opening of an era unparalleled in the history of the world for steady and substantial progress in every branch of human endeavor.

Each generation retells the story of past achievements in its own way. The use of ether for the relief of pain has become one of those twice told tales which it is a pleasure to recall and an honor to relate. The story itself, however, full as it is of human interest and dramatic elements, will not here be repeated, for it seems more to the purpose to consider some of the progress which in no small part was made possible by the introduction of the experimental method as exemplified in the discovery of ether and its application as an anesthetic.

#### A CONSTRUCTIVE PROGRAM.

Formerly hygienic and sanitary measures were based almost solely upon a negative program. This was necessarily so because we had to await the exact observations of Pasteur before the sanitary sciences could be placed upon a sound basis of fact. The old books of hygiene were full of fads and fancies. By the old books I do not mean ancient tomes, but the books which were regarded as authority when I was a medical student. The whole sanitary system was then a vague or confused jumble and an uncertain guide. The system was an assemblage of sanitary don't's. We were told what not to do, in order to avoid infection, or to improve our bodily vigor. When the sanitarian of yesterday did depart from this negative program and ventured to give counsel of a positive character, it turned out to be mostly guesswork and very often wrong.

When I was a boy they told me not to catch cold, but they could not tell me what to do in order not to catch cold, and if they did it was mostly poor advice. Thus I was taught to fear the night air, whereas now we know that the air by night is cleaner than the air by day in that it contains less dust and fewer bacteria; our common sense confirms the observation that the night air in itself contains

no injurious qualities. Patients with tuberculosis, and even pneumonia, are freely exposed to the health-giving tonic properties of the cool night air.

There must be many present who have heard about the noxious emanations and poisonous miasmata wafted mysteriously in the night air, to fret and plague us. This notion that the night air is harmful was a logical conclusion drawn from the observations made from time immemorial that malaria stalks by night. The reason for this is quite clear to us now since we know that the malarial mosquito, like the tiger, prowls at night in search of its quarry. In warm malarious regions the misinformed folk close all the shutters of the house very tightly at nightfall in order to keep out the dreadful malarious miasm, thus imperfectly guarding against mosquitoes, and at the same time favoring the spread and development of tuberculosis, which is especially rife in the tropical belt. I have often observed that when one of these benighted people sallies forth into the night air he throws a scarf over his mouth and nose in order to filter out the poisonous effluvia from the air he is breathing. At the same time I have seen large ferocious anopheles mosquitoes freely biting the hand that held the scarf in place.

Furthermore, when I was a boy I was swathed in flannels and partially parboiled in overheated schoolrooms; my vasomotor tone was so relaxed by this coddling that it could not respond promptly to aid my heat-regulating apparatus in an effective manner. My nasal mucosa was soggy and sensitive. Therefore, I was susceptible to colds and was taught to fear drafts. We now know that colds are caught from other persons having colds, just as diphtheria is contracted from diphtheria. Arctic travelers exposed to all the rigors ordinarily supposed to produce colds do not suffer from these ailments until they return to civilization and become infected by contact with their fellow-men. It is not the engineer in the cab who catches cold so much as the passengers in the crowded, stuffy, overheated and dusty Pullmans.

The term "common colds" is used here to mean the acute

infections of the mucous membranes of the upper respiratory passages. It does not include the many acute and chronic congestive inflammatory states due to reflex mechanical or chemical irritants to which these parts are directly exposed and to which they often become exquisitely sensitive.

In brief, then, we are now able to tell people that the way to guard against common colds is primarily to avoid other people having colds, and to cultivate hygienic habits that will lessen the chances of the infection reaching the mouth and nose; secondarily to improve bodily vigor so as to increase our resistance to infection. It should be carefully kept in mind, however, that general physical vigor is no certain safeguard against most of the infections to which flesh is heir. The strong and robust are too often stricken down in the prime of life with scarlet fever, diphtheria and even with pneumonia, tuberculosis or typhoid fever, or some other infection of our long repertoire.

It is very much easier to tell a person what to avoid than to teach him what to do. We need constructive lessons in hygiene as well as in ethics. Seven of the commandments of the decalogue are negative. Almost all secular laws are negative. Jurists, learned in the philosophy of the law, tell us that it is important that laws should be thus limited so as to permit independence of action. The law may properly state what a person may not do, but it should be careful in dictating what he must do. In hygiene and sanitation, however, we cannot be satisfied with this negative program, for we now have sufficient knowledge to teach and guide the people in the positive art of hygienic living. Even the law, when applied to preventive medicine, recognizes this principle. "The liberty secured by the Constitution," says the Supreme Court of the United States, "does not impart an absolute right in each person to be at all times and in all circumstances wholly freed from restraint. Real liberty for all could not exist under the operation of a principle which recognizes the right of each individual person to use his own, whether in respect to his person or his property, regardless of the injury that may be done to others."



As soon as the sanitary sciences took a proud place among the exact sciences (with due apologies to the mathematicians) the art of preventive medicine had its birth. Preventive medicine is an art based upon many sciences. It is an art that has reached the satisfactory stage when we are able to foretell many natural events in the epidemiology of disease with an accuracy not dreamed of by the prophets of old.

Other sciences and their arts have passed through the same evolution that is so evident in the history of sanitation. All science in its infancy and immaturity flounders and crawls in a negative nursery. The dawn of a positive program foreshadows the day of useful achievements. Sanitary science has graduated from the kindergarten stage of negation and is now passing into the grammar grade of assertion. We are now witnessing a remarkable renaissance in every science, resulting in a transitional period of progress which characterizes the promising though perturbing period in which we live. When the history of this period is written the historian will be embarrassed with a wealth of material progress along every line of human endeavor, but "when earth's last picture is painted, and the tubes are twisted and dried," one achievement will stand out clearly above all the rest, and that one is the conquest of disease.

#### SOME HYGIENIC FALLACIES.

The new hygiene has given us an entirely different conception of many of the factors that enter into health and disease. It has exploded many a world-old fallacy. We know, for example, that there is practically no more danger from sewer gas than the farmer subjects himself to on his manure pile. The old bugaboo of sewer gas dies hard. People have always believed and still naturally cling to the notion that anything that smells bad must be detrimental to health. Science has demonstrated that our sense of smell is a poor sanitary guide. It is certainly absurd to accuse the emanations from defective plumbing of being the source of diphtheria, typhoid fever, scarlet fever, sore throat, or any other infection.

Fomities or inanimate things were formerly supposed to play a large rôle in the transmission of infection. We know that in fact this occasionally happens, especially with diseases spread through discharges from the mouth and nose. Instead, however, of accusing letters, books, umbrellas, walls, furniture, merchandise, and other unlikely things, which were formerly disinfected or destroyed, we now think of objects recently moistened with saliva, such as drinking cups, pencils, toys, towels, as well as food, fingers and flies. Yellow fever was believed to be transferred by a great variety of objects—coffee sacks, mattresses, a tress of hair, cigarettes smuggled in the false bottom of a trunk, were all accused of starting epidemics before the researches of Reed, Carroll, Lazear and Agramonte. Many of our former sanitary practices now seem absurd in the light of present-day knowledge. While quarantine officer in Havana, I disinfected, in accordance with the government regulations, and by order from my superior officers in Washington, every letter that left the island, as well as great quantities of wearing apparel, and other articles suspected of carrying the virus of yellow fever. I even used to disinfect the ballast of wooden vessels, and in the case of rock ballast, dipped every stone separately into a tub of bichloride of mercury for fear that some small facet would escape purification. Again, while quarantine officer in San Francisco, before the knowledge that rats and fleas are the chief agent in the spread of plague, I used to disinfect great quantities of foodstuffs and merchandise, which was the best we knew in those days. I well remember how the merchants objected to having certain Chinese fruits dipped in formalin. When, however, we discontinued the process as useless there was still greater objection because the merchants had discovered that the formalin treatment helped to preserve some of these perishable goods for a considerable period of time.

Many a person obeys the call "back to nature" with direful results, for when he gets into nature's solitude he thinks he can disregard nature's laws. Sanitary habits are quite as important in the wilds as in the tenements. It especially grieves the heart of the sanitarian to note how

frequently people contract typhoid fever at country, mountain or seashore resorts. The excess of typhoid fever in the autumn now goes by the special name of "vacation typhoid." The unsanitary conditions found in many sparsely settled communities temporarily occupied during the summer season often challenge the conditions found in military camps during the bow and arrow age. Before people leave the sanitary security of a well-guarded city for vacation grounds, they should demand a bill of health from the health officer.

Sometimes science will change our views in a revolutionary manner, but these altered views may not materially change the practice of our art.

Thus our entire conception of ventilation has changed, owing to the fact that we now do not believe that fresh air is particularly necessary in order to furnish us with more oxygen or to remove the slight excess of carbon dioxide. It is plain that it is heat stagnation that makes us feel so uncomfortable in a poorly ventilated room rather than any change in the chemical composition of the air. It has been made perfectly clear from the work of Flugge that one of the chief functions of fresh air is to help our heat-regulating mechanism maintain the normal temperature of the body. It is necessary to have some 2000 to 3000 cubic feet of air an hour to maintain our thermic equilibrium—just the amount that was formerly stated to be necessary to dilute the carbon dioxide and supply fresh oxygen. The practice of ventilation, therefore, has not altered so much as has our reason for attaching importance to clean, cool, moving air, which has completely changed.

One of the fallacies that has fallen is the relation of the air to the spread of infection. The virus of most communicable diseases was believed to be in the expired breath, or exhaled as emanations of some sort from the body. These emanations were said to be carried long distances,—miles—on the wind. The easiest, and therefore the most natural way, to account for the spread of epidemic diseases was to consider them as air-borne. Nowadays the sanitarian pays little heed to infection in the air except in droplet infection, and the radius of danger in the fine spray from the mouth

and nose in coughing, sneezing and talking is limited to a few feet or yards at most. The more the air is studied the more it is acquitted as a vehicle for the spread of communicable diseases.

It was a great surprise when bacteriologists demonstrated that the expired breath ordinarily contains no bacteria. Most microorganisms, even if wafted into the air soon die on account of the dryness, and especially if exposed to sunshine. The relation of the air to infection is nowhere better illustrated than in the practice of surgery. At first Lister and his followers attempted to disinfect the air in contact with the wound by carbolic sprays. Now the surgeon pays no heed to the air of a clean operating room, but ties a piece of gauze over his mouth and nose, and also over his hair, to prevent infective agents from falling into the wound from these sources.

A similar revolution is recorded in almost every chapter of the great book of preventive medicine. With this increase of knowledge has resulted a corresponding increase in efficiency. We are now enabled to apply our preventive measures with an assurance of success not hitherto possible. It is quite easy to work in the midst of a raging cholera epidemic without contracting the disease; this was clearly shown in Hamburg in 1892. It is still easier to nurse and attend patients with smallpox without taking the infection. A well-screened yellow fever hospital is the safest place in an outbreak, as was demonstrated during the last epidemic in New Orleans in 1905. It is quite practical with bacterial vaccines to raise our immunity to typhoid fever, plague, and a number of other infections. Furthermore, the methods of a clean hygienic life are better understood than formerly.

Milk is responsible for outbreaks of typhoid fever, scarlet fever, diphtheria, septic sore throat, and is also responsible for a certain amount of tuberculosis and infantile diarrhea. These facts make it quite certain that many diseases formerly attributed to pollution of the soil, to effluvia from broken drains, or some other indeterminate cause, were in reality due, in part at least, to impure milk. Milk,

then as now, must have been a factor for the spread of the agents of infection. It took a long time to find out that these infections may be transmitted in milk and that the danger may be neutralized by such a simple, harmless and efficient process as pasteurization.

Many people delude themselves with the false hope that there is some drug to cure every disease. The specific remedies may be counted on the fingers of our hands. Very few therapeutic agents rival quinine for malaria, salvarsan for syphilis, or antitoxin for diphtheria, and even these must be properly administered in order to obtain satisfactory results. The common belief that there is some drug that will cure every disease is fostered by unscrupulous persons who boldly advertise "sure cures" for rheumatism, pneumonia, cancer, tuberculosis, diabetes, and Bright's disease. These fallacies quickly disappear when people become better informed as to the limitations of the pharmacopeia—quackery will then be less prosperous.

Many other fallacies are fostered. The ozone myth is one of them. Ozone is an irritating and poisonous gas. It conceals faults in ventilation while not correcting them. Ozone will destroy mammalian life more quickly than it will destroy bacterial life, hence it has no useful disinfecting power in occupied rooms. The sanitarian classifies ozone as a poison, not as a purifier, and believes that the recent ozonizing machines advocated for offices, schools, theatres, and other places, are mischievous.

All those who have given thoughtful study to the pure food situation as it now exists are agreed that the pure food question is an economic rather than a health problem. To discuss this and other fallacies would require endless time. Only a few are mentioned as examples.

A deeper insight into the causes and method of transmission of disease has robbed infection of the terror with which the dread of epidemics once staggered mankind. For graphic descriptions read Defoe's "Journal of the Plague Year," or S. Weir Mitchell's "A Red City." It is difficult for those who have not witnessed the panic of a



fever-stricken city to realize the terror, the flight, and the paralysis of trade, all due to a helplessness and hopelessness, the result of ignorance. Knowledge has, therefore, given us confidence that has conquered a fear of infection as supernatural and has mastered a superstitious dread of its mysteries. This conquest is one of the milestones which marks the advance of mankind.

#### CONQUEST OF THE FEAR OF THE SUPERNATURAL.

It is difficult to measure the advance made by mankind; in fact, it is even doubted whether man has made any real progress since the dawn of written history. I am optimistic enough to believe that man has made great strides physically, mentally and spiritually. Physically, man is better off on account of a better understanding of the world in which he lives. Mentally, he is superior to his remoter ancestors on account of a clearer understanding of truth and how to find it, and both these facts have greatly influenced the spiritual yearnings that distress every soul.

We no longer personify everything about us with a childlike anthropomorphism, although there is still a universal tendency among mankind, as pointed out nearly one hundred years ago by David Hume, whose philosophy gains strength with advancing age, to conceive all beings like ourselves, and to transfer to every object those qualities with which we are familiarly acquainted. We now look out into the world unafraid, and with a faith born of a knowledge of nature and her laws. The scientific spirit has freed us from the trammels of tradition; we are now permitted to question, invited to doubt, and today we boldly investigate, even with public approval, forbidden subjects of yesterday.

It is so plain to us now that the length of a vibrating string determines the sound it produces that it is difficult for us to put ourselves in the place of those who formerly thought that they heard the voice of Eolus. We know the lightning is not the wrath of Jove, the eclipse is not a shadow of portending evil, and the wind "bloweth where it listeth" on account of differences in weight between cold

and warm gases. Knowledge has begotten wisdom, and wisdom has given us confidence that would have been regarded as rashness, if not impiety, in other days.

Best of all, perhaps, is that definite information concerning the agents of infection which at one stroke has taken them out of the supernatural.

The influence of some supernatural power with reference to disease still lingers in the minds of many who take the fatalistic attitude that if we are going to be sick we are going to be sick, and nothing that man can do will avert it. The very names of a number of diseases give sanction to this belief. Thus erysipelas was long called St. Anthony's fire, and scrofula the King's evil. Chorea is still called St. Vitus' dance. Persons with epilepsy or insanity were believed to be possessed of the devil, and many charms were worn to guard against the evil spirits, and many strange devices were used to dispossess them. There is an account of the plague in Rome about the time of Esculapius in which it is related that great fires were built in the streets, and a great noise was made in order to frighten away the demons. The plague, in fact, soon ceased, but we are now inclined to think it was because the continued fires and alarum scared away the rats rather than the evil spirits.

The fatalism that still binds the minds of men was well shown in the hookworm campaign. The greatest barrier met with in eradicating hookworm disease was the prejudice and ignorance of the people and profession. Until this was overcome the measures to help the infected people were fruitless.

A knowledge of the natural history of disease has drawn the teeth of many an ancient mythical dragon. Certain diseases recur annually like the deciduous plants. We have our annual crop of typhoid fever just as we have our annual crop of thistles; we have tuberculosis perennially just as we have evergreen firs and balsams. The appearance and disappearance of some diseases can be predicted with the same certainty as the seasonal appearance and disappearance of plants. Epidemics of measles in Richmond, Va., have been foretold with the same certainty as the decline of water-borne typhoid fever in Pittsburg.

Formerly, when yellow fever broke out in our Southland, the fever-stricken city was paralyzed both with fear of the disease and with the terrors of a shotgun quarantine. Now, yellow fever cases arriving at Havana are fearlessly carried through the city in a screened ambulance to Las Animas Hospital. We need no longer fear plague, typhus fever, relapsing fever, and other maladies in the way they once terrorized a less informed and less sanitary age.

The definite knowledge concerning most infections and the natural laws governing their transmission has given us a confidence that has properly robbed these diseases of the supernatural dread which once invested them. We know that the inscription, "Died by the grace of God" on many a tombstone, should read, "Died by the disgrace of infected milk" or polluted water, or some other preventable factor.

Every scientific discovery contributes to the physical, intellectual and moral betterment of the world, but the discoveries in preventive medicine have made the lot of man so much easier, and this life so much safer, that he has more time than ever to think of his neighbor and to share his blessings with him. More than this, preventive medicine has quickened the coming of the brotherhood of man, for it has pricked his conscience in an extraordinary way.

#### A SANITARY CONSCIENCE.

One of the most remarkable developments of this age in which we live is the awakening of a sanitary conscience. It is a new thought in the mind of many a man that the care of the body and cleanliness of surroundings is a very considerable factor in the comfort, safety, and even the life and health of his fellowmen. The sense of moral goodness which comes from a clean and hygienic life is part of the doctrine of sanitary righteousness. Preventive medicine teaches that we must not only safeguard our own bodies against infection, and keep our own surroundings clean for our own sakes, but quite as much for our neighbor's sake. It teaches the lesson of the unselfishness of community interest and has been a potent biological factor



which underlies the present trend towards socialism. One man alone cannot fight the fight against the common foe—infection; it takes the combined and intelligent coöperation of the community.

One of the best instances that comes to mind is the case of vaccination for smallpox, which was the first and remains one of the great achievements in preventive medicine. Vaccination affords a very high degree of protection to the individual and a well-nigh perfect protection to the community. Vaccination and revaccination systematically and generally carried out will completely erase smallpox from a nation. In other words, while the individual protection is not always perfect, the communal protection is absolute. To remain unvaccinated, therefore, is selfish, in that by so doing a person steals a certain measure of protection from the community on account of the barrier of vaccinated persons around him. In England the Conscience Clause permits many persons to remain unvaccinated because the law exempts persons whose religious scruples forbid compliance therewith. Our own Supreme Court wisely forbids any such exemption in states having vaccination laws.

No man has the right to endanger his fellowmen with infection any more than he has the right to endanger him with physical injury. The Supreme Court of Minnesota, Dec. 23, 1910, in the case of a water-borne outbreak of typhoid fever, held that "the state is liable if damages can be proved." This decision places the responsibility where it should be. Citizens are evidently as much entitled to reasonable sanitary protection as they are to police protection, or to protection from accidents at grade crossings. It is a fortunate day for preventive medicine when the principle is recognized that sanitary negligence is just as culpable as the negligence which fails to place a red flag by day or a red lantern by night to guard against a pitfall in the public highway. Returning again to vaccination, we find that the experience of over one hundred years clearly demonstrates its benefits, and we see that Germany has taught the world how to apply the known facts. If the entire world would follow the example of Germany then

Thomas Jefferson's prophecy to Jenner that "future nations will know by history alone that the loathsome smallpox has existed and by you has been extirpated," would soon be fulfilled. Sanitarians know that it would be much simpler to render smallpox extinct than it was to stamp out yellow fever from the Canal Zone.

In the case of rabies we have another instance in which the sentiment of selfishness of man permits his fellows to suffer from preventable disease. A better understanding of the facts would soon make it plain that death from hydrophobia is as unnecessary as death from an unprotected cogwheel. England has eliminated rabies, and Australia has kept it out through muzzling ordinances and quarantine on dogs. Muzzling temporarily inconveniences the dogs, but in the end protects dogs as well as man and other animals from this communicable infection.

The laws of biology have a direct bearing upon our daily life, and a correct understanding of these laws helps us not alone to a longer and healthier, but to a better life. Many ethical questions that trouble our complex age can also be solved by an intelligent understanding of biology, just as many material questions relating to health and disease depend upon a deeper insight into the medical sciences.

All enduring progress must be based upon morality, but our very interpretation of morality, as it influences our conduct of life and our relations to our fellowmen, is based upon, and guided in no small degree by a correct understanding of the world about us. It is plain to the student of biology that the rich harvest of facts garnered by the experimental method in all the fields of science during recent years has gradually but inexorably impressed itself upon the changing code of ethics of all civilized nations. The criminal of yesterday derided and jailed is the patient of today sent to the hospital for treatment; the vicious individual or the incompetent moron is not now regarded as deserving the finger of scorn so much as he is entitled to the humanity that recognizes the condition as one of imperfect protoplasm, caused by a natural limitation due perhaps to hereditary faults in his ancestors; the insane

are no longer laughed at as bewitched, but treated with a consideration and humanity based upon a clearer understanding of their diseased states. How different all this is from the time audiences roared at the antics of King Lear as a comedy character, and people visited Bedlam as a source of amusement. A drunken character on the stage is no longer greeted with peals of laughter, but with a feeling akin to sorrow and disgust. We no longer declaim that all men are created free and equal, for we know that they are bound by their protoplasmic makeup, and unequal in their powers and responsibilities.

The responsibility of individuals and the limitations of an imperfect human machine are much clearer to us than formerly. Infection is no longer regarded as a punishment for sin, or even sin itself, much less a supernatural visitation, but simply a conflict between two beings, one the host and the other the parasite. In one sense this conflict, though less obvious, is not essentially different from the conflict between a rattlesnake and his prey. The battle between host and parasite results in a reaction in the host and this reaction we call an infectious disease. The various elements which make up this conflict, such as the mode of attack of the parasite and the means of defense of the host, have been carefully studied. A sharp defense on the part of the host will sharpen the claws of the parasite in accordance with the laws of the survival of the fittest, and thus increase the reaction or the intensity of the disease. If the parasite is unduly aggressive and virulent, and thus kills its host too quickly, it defeats its own object, for the parasite is in the position of the rats on a ship. It serves small purpose to scuttle the ship unless there is some means of passing to another ship. The mode of transference of the parasite is therefore of vital importance to the parasite, and of great practical concern to the host. The infectious diseases, then, represent, only one phase in a complex series of events in which parasite and host are inter-related, not only as rats on a ship, but as seed and soil.

The cornucopia of preventive medicine is not overflowing but is filling up with blessings of various sorts. One of

the most important when gauged by practical results is a better understanding of the sources of infection and their modes of transference. It is much more important for the health officer to know the ways in which the virus is transmitted from one person to the next than to know the causes of disease. Thus with yellow fever we are enabled to prevent it or check an epidemic, although still ignorant of its cause.

#### SOURCES OF INFECTION AND MODES OF TRANSFERENCE.

There are two great sources of the communicable diseases of man, viz., man himself, and the lower animals. Most of the communicable diseases of man, especially those which occur in epidemic form, are peculiar to man. This is the case with typhoid fever, cholera, leprosy, malaria, yellow fever, syphilis, mumps, measles, scarlet fever, typhus fever, infantile paralysis, cerebrospinal fever, smallpox, chickenpox, relapsing fever, dengue, and even tuberculosis in large part. It is quite true that some of these infections may be communicated to the lower animals under experimental conditions, but they do not, as a rule, occur in them under natural conditions. In other words, most of the communicable diseases from which man suffers are specific; the degree of specificity varying slightly with the different infections.

It is, therefore, plain that man is the great source and reservoir of human infections. Man is man's greatest foe in this regard. The fact that most of the communicable diseases must be fought in the light of an infection spread from man to man is one of the most important advances in preventive medicine. This new thought has crystallized out of a mass of work in the sanitary sciences during the past decade, from researches upon tuberculosis, typhoid fever, cerebrospinal meningitis, and other communicable diseases. Formerly sanitarians regarded the environment as the main source of infection. We now know that water, soil, air, and food may be the vehicles by which the viruses of the communicable diseases are sometimes transferred—that is, they are media of conveyance rather than

sources of infection. Most of the microorganisms causing the communicable diseases of man are frail and soon die in our environment, as in the air, soil, or water. Most of them are obligate pathogens and cannot or do not grow or multiply in our environment.

From the lower animals, particularly the domesticated animals, man contracts a number of infections. Thus we contract rabies from dogs, plague from rats, glanders from horses, trichinosis from hogs, malta fever from goats, anthrax and foot-and-mouth disease from cattle, tuberculosis, in part, from cattle; tapeworms and other animal parasites from the meat of fish, fowl, and mammals. Various skin parasites are also contracted from the lower animals, as ringworm from cats. The number of diseases, however, contracted from the lower animals, and the extent of their ravages are notably less than those contracted from man himself.

The knowledge that most infections are spread rather directly from man to man combines the forces of sociology with those of preventive medicine. The task of preventive medicine is thereby rendered much more difficult from the fact that the control of most infections depends upon the control of man himself. The elimination of smallpox, and that still worse plague, the great pox, illustrates the well-known principle in preventive medicine that it is much more difficult to control a disease transmitted directly from man to man than a disease transmitted by an intermediate host or one contracted from the lower animals, or one transferred to us from our environment. We have a certain amount of control over our surroundings, and we have dominion over the lower animals, but the control of man requires the consent of the governed. Thus it is easier to stamp out yellow fever than to control typhoid fever. It is easier to suppress malaria than tuberculosis, rabies than influenza, trichinosis than syphilis. Cattle appear to be mutely thankful when protected by inoculation against blackleg or anthrax, but man rebels against one of the best of all specifics—vaccination against smallpox. The fact that man is the chief source and reservoir of most of his



own infections adds greatly to the scope and difficulties of public health work, and often makes the prevention of disease depend upon social changes. In this sense preventive medicine has become one of the important factors in sociology.

The agents of infection may take various routes of transference from man to man or from animal to man. These routes are spoken of as the modes of infection, the mode of transference, or sometimes as the vehicles of infection. Formerly they were spoken of as the "channels of infection," but now we restrict that term to the special channel by which the infection enters the body. Thus the channel of infection in tuberculosis may be the respiratory tract, the digestive system, or the skin; whereas the mode of infection is from tuberculous sputum, either by direct contact, by droplet infection, or through milk or some other medium of conveyance.

The modes of transference may be grouped, for convenience, under three general heads: (1) direct, (2) indirect, and (3) through an intermediate host. In the great majority of cases, however, the virus is transferred more or less directly by what is now known as contact infection. In many instances the virus is transferred indirectly through water, food, soil, air, etc. In a large group of diseases the transfer is through an intermediate host which furnishes the growing list of insect-borne diseases. The above facts bring out a significant distinction between hygiene and sanitation.

#### HYGIENE VERSUS SANITATION.

We now know that purifying water and pasteurizing milk will decrease but will not delete typhoid fever. Residual typhoid fever must be fought in the light of an infection spread from man to man, that is, in the light of a contagious disease. It has often been said that typhoid fever is infectious but not contagious. There is much mischief in that statement, for it is clear that typhoid is both contagious and infectious, or, as we prefer to say, communicable. These words, "contagious" and "infectious"

are popular terms lacking precise definition, and the distinction serves no useful purpose. Contagious diseases may be infectious and infectious diseases may be contagious. The distinction is artificial and should be dropped.

Modern science teaches that tuberculosis is both contagious and infectious, but not hereditary, as was formerly supposed. Tuberculosis is an example of a disease that must be fought along both hygienic and sanitary lines, that is, hygienic living to improve the resistance against the infection and sanitary habits and surroundings to diminish the chances of contracting the virus.

A distinction is therefore growing up between the old terms "hygiene" and "sanitation," which are the Greek and Latin equivalents for health. More and more are we limiting the word "hygiene" to the person, and "sanitation" to the environment. Hygiene is personal, sanitation impersonal. Thus we speak of the hygiene of the school children, but the sanitation of the school buildings. We speak of the sanitation of the Panama Canal Zone, but the hygienic condition of the workers. Before the present renaissance of the sanitary sciences these two terms, "hygiene" and "sanitation" were used more or less interchangeably. The distinctions are growing necessary as a result of our enlarged knowledge.

#### CLEANLINESS THE HEART AND SOUL OF SANITATION.

Although science has shown the increased importance of a personal hygiene, it has not diminished the value of impersonal sanitation. Environment has been shown to have very little to do with the spread of a large number of diseases, of which scarlet fever, diphtheria, whooping-cough, measles, smallpox, syphilis, mumps, cerebrospinal fever may be taken as examples. In view of these facts there has been a tendency on the part of some health officers to exaggerate the importance of the person in the transfer of disease, and to neglect the environment. There is a large and important group of diseases in which the care and cleanliness of our surroundings are of great concern. This class is represented by those infections spread by the

alvine discharges, such as typhoid fever, cholera, hookworm disease, dysentery, and others caused by intestinal parasites. These diseases were formerly called "filth diseases." That term is dying out since the domination of a personal hygiene over sanitation. At one time the conception of the filth diseases reached the dignity of a special name—the "pythogenic theory"—first propounded by Murchison in 1858. Although Murchison's conceptions were quite wrong, we should not forget that typhoid fever is really a filth disease—at least a filthy disease, because every case means that a short circuit has been established between the discharges from one person and the mouth of another.

The mistake should not be made that simply because dirt does not breed disease it may be neglected, because the filthy garbage can does not emit diphtheria it may be tolerated, and because the foul odors from decomposing organic matter do not carry with them the effluvia of any known disease, they may be permitted. No mistake could be greater. Cleanliness is still next to godliness, and it is just as important from the standpoint of personal hygiene as ever. Cleanliness of mind and body, cleanliness of home and surroundings, cleanliness of city and country, cellar and garret, wharf and shop, markets and roads, cleanliness of the air we breathe, water we drink, food we eat, and habits we cultivate, are the substantial foundation blocks for an enduring structure of preventive medicine. The dearly bought experience of the ages has taught mankind the lesson that cleanliness makes for health, while the reverse encourages disease. Only two years ago a well directed and energetic sanitary campaign practically abolished typhoid fever from Yakima County, Washington, where the disease was unduly prevalent, simply by a "general cleaning up." This demonstration was one of the great object lessons in modern sanitation that has not been given the attention it deserves.

Our conception of cleanliness has greatly changed with our advance in knowledge of the kinds of dirt, the degree of dirtiness, and the nature of these dangers. We can no longer be satisfied with visible or esthetic cleanliness, but



must insist upon biological cleanliness. A tetanus spore upon the shining blade of a surgeon's knife makes that instrument filthy, whereas many such spores on the skin of a chicken may be harmless when ingested. We cannot see the infection upon the common drinking cup, upon the roller towel, upon the point of a pencil that has just been moistened with saliva, or in water, milk, or food, although we well know the danger of such invisible "dirt" that these objects may harbor.

It requires a bacteriologist to tell the difference between clean dirt and dirty dirt. We lack a sixth sense, or microscopical eye to see and distinguish the harmful germs. Furthermore, cleanliness, in the modern understanding of the term, involves the absence of flies, fleas, mosquitoes, bedbugs, lice, rats, mice, and all sorts of vermin. We must therefore practice scrupulous cleanliness and educate the people to the biological meaning of this term. Long experience has taught the lesson that cleanliness offers a mode of protection against disease, that clean surroundings are apt to be free from infection, and that clean food is apt to be safe food.

Before the rise of a personal hygiene the health officer was a general scavenger. His chief duty was to abate nuisances, collect garbage, inspect plumbing, and look after pesthouses and lazarettos. The sanitarian now knows that rubbish, manure, and organic wastes of all kinds are not sources of infection, although they may favor the spread of infection. Vermin breed and feed where dirt of this nature is tolerated. Rubbish in vacant lots, or back yards, in alleys, in cellars, garrets, and other places may, therefore, be taken as an index of the failure to appreciate the modern teachings of hygiene and sanitation. One of the most pernicious results of dirt is dust. Dust is irritating and injurious. Dusty roads, dusty houses, and dusty workshops mean dirt and neglect. Some kinds of dust are more trying than others, but all kinds are injurious.

Fresh air and sunshine are natural aids to cleanliness. They destroy infection and purify surfaces. As surface disinfectants, fresh air, sunshine, and cleanliness rate

higher in the opinion of most sanitarians than the germicidal gases used to fumigate a room.

The subject of cleanliness cannot be left without a word about decency as applied to hygiene and sanitation. The health officer is no longer swayed by sentiment, but guided by facts. Nevertheless, sentiment cannot be disregarded in sanitation any more than we can banish music, or beauty of form and action from the heart of man. The sanitarian frowns upon many things which he knows may not be particularly harmful. If dried figs contain a few worms they pass muster, but if they contain many they are condemned for decency's sake; the other day our State Board of Health condemned a lot of foodstuffs that had been in cold storage over a year, not because they thought the food particularly harmful, but an unnecessary practice and one fraught with potential danger, however slight, in other words, contrary to public decency. Much meat is condemned not because particularly harmful, but people object to it on sentimental grounds. When prices soar higher and we become flesh hungry as some European nations now are, we will use many food animals that are now condemned. We now no longer think it decent to drink water containing sewage, even though boiled. Filtration will strain out the infection but will not eliminate the dissolved chemicals. It took mankind a long time to awaken to the fact that the inexpressibly nasty habit of drinking water polluted with sewage was not only not nice, but dangerous. In Italy the signs in the railroad carriages read, "For hygiene and decency do not spit." The moral is obvious.

It would be impossible for the present-day sanitarian to improve upon the oft-quoted sentence, "cleanliness of the person is the threshold to cleanliness of the soul, and hence the door to righteousness." We need only to refer to the Levitical laws to become impressed with the fact that the practical value of cleanliness is not a new thought. Thus we read in Deuteronomy "thou shalt have a place also without the camp whither thou shalt go forth abroad, and thou shalt have a paddle upon thy weapon and it shall be when thou shalt ease thyself abroad thou shalt dig there-

with, and shalt turn back and cover that which cometh from thee." This is an instinctive act among animals, and may be seen daily in the habits of the domestic cat. Even wild animals take the greatest pains not to foul their nests, yet how different it often is with men in a civilized state. Formerly man literally lived on a dung heap. If the above primitive injunction concerning camp sanitation had been followed by our troops in the Spanish-American war it would have saved thousands of cases of sickness and deaths from typhoid fever. The statistics show that about one-third of our entire command in that war contracted this filth disease and largely because proper precautions were not taken concerning the disposal of excreta. During the recent flare-up in Mexico our troops were concentrated on the border near San Antonio in Texas. This command, known as the Texas Manoeuvre Division, consisted of about 20,000 officers and men, and among them were only two cases of typhoid fever. This was in part due to the fact that practically all the officers and men were vaccinated against typhoid, but this alone by no means explains the freedom from the disease, for in addition the camp was a model of cleanliness and sanitation.

Concerning bacterial vaccines, a warning is necessary. The sanitarian welcomes every specific therapeutic agent as he welcomes anything that helps check the prevalence of the communicable diseases. He doubts, however, the advisability of artificially raising immunity by means of bacterial vaccines as a wise measure for the population at large. Persons who have to visit a city during a typhoid outbreak, or physicians, nurses and ward tenders in the typhoid wards of hospitals, or travelers in a country where typhoid is endemic, or soldiers in a camp, or persons unduly exposed, should protect themselves with typhoid vaccine. The immunity thus produced, however, does not permit them to heedlessly disregard the rules of sanitation and hygiene. The sanitarian believes that it would be much better to fight typhoid and also tuberculosis along the lines of hygiene and sanitation, even though it may take a long time to conquer these infections, but once conquered along these lines the victory will be enduring.

## SANITARY ISOLATION.

Sanitary isolation is an impossibility. Any system of quarantine that attempts to protect with a Chinese wall is doomed to fail. Massachusetts might today free itself of measles or tuberculosis, but tomorrow it would become re-infected from neighboring states. Infection flows from the country to the city, therefore no city is safe with infected suburbs, or especially with infection upon the drainage basin from which the water supply is obtained, or upon the milk drainage area. Germs are social climbers and find their way into the palace on the plaza or the castle on the crags. We can place a social guard at our front door, but there is no sanitary watchman to protect the back door. A typhoid bacillus does not ride up with a footman and livery and announce his call with his name emblazoned on a visiting card. He may come unannounced into the best ordered house in a bottle of milk, or in the person of a housemaid or workman. So long as slums are permitted and crowded tenements are tolerated, those who live on the boulevard are not safe.

Man's protection of his fellowmen has, therefore, become a matter of individual concern. It is not only a question of self-preservation, but the health and happiness of those near and dear. Man's sanitary duty to his fellowmen answers the question, "Am I my brother's keeper?" Formerly each individual or each community heedlessly allowed its sewage to run into the stream, without a thought of those who drank the water below. Cities upon lakes emptied their sewage into the lake and took the diluted sewage at another point close by. Today a man's sanitary conscience should not allow him to defile the stream. If his sanitary conscience does not prick him, then the sanitary police should compel him to have a due regard for the rights and safety of others.

The discovery of carriers has increased the difficulty of sanitary isolation. In many diseases carriers are more numerous than the cases. Thus from 2 to 4% of all cases of typhoid fever become carriers. In cerebrospinal fever

the carriers outnumber the cases 10 to 1. It is believed that the missed and abortive cases of infantile paralysis are much more numerous than the paralytic cases so easy to recognize. The carrier problem has greatly complicated the program and renders the process of eliminating certain infections complex and difficult.

There is, however, reason to believe that the time will soon come when carriers will be cured, and, better still, we know that many of them can be prevented by early recognition of the case and intelligent isolation of the patient. Every case of infectious disease known is a case neutralized, and experience teaches that the number of carriers diminishes in a community *pari passu* with the decrease in the number of clinical cases. Isolation with all its imperfections and disappointments will continue to remain an important measure to check the spread of infection.

Sanitary engineering works, especially those involving disposal of sewage and wastes, purification of water or drainage of land, require a large outlay of money. The expenditure, however, is economical in the light of the benefits derived. The sanitarian knows no greater extravagance than the false economy in matters of this sort. Communities are gradually awakening to the fact that these things pay. A healthy city attracts trade and travel, and people are now rightly demanding a clean bill of health from communities with which they have personal commerce. "Public health is purchasable; within natural limitations a community can determine its own death-rate." It seems strange that such an intangible and mysterious quality as health, long regarded as a gift of God, should become a commercial article to be bartered in our legislature halls.

Legislators often do not heed the demands of the few for a number of reasons. Science has run ahead of public health administration by leaps and bounds, so that there has been more than the usual lag in the diffusion of the new knowledge. Again it is difficult for legislators to winnow the wheat from the chaff out of the harvest of novelties, half truths, theories and speculations that fill the barns of the experimenters. Furthermore, science deals only with cold



facts and will have nothing to do with emotions, intuitions, instinct or other categories that philosophers make so much of. The very fact that science limits itself strictly to facts that may be measured or weighed is at once its strength and its weakness. Man is not simply made up of a material aggregation of matter, and therefore the discovery of a method of preventing or curing disease cannot always be applied immediately. There are many complicating factors between the discovery of a new fact and its practical application. For example, we have sufficient information to stamp out hookworm disease, malaria, beriberi, and many other afflictions, but they continue and are likely to continue to decimate the ranks for many generations to come. When Ronald Ross had worked out the life history of the malarial parasite in the mosquito he broke out into song:—

"I know this little thing  
A myriad men will save.  
O Death, where is thy sting,  
Thy victory, O grave."

But although we know the cause of malaria, its mode of transmission, and although we know how to prevent it, and even possess a cure, the disease still counts its victims by the hundreds of thousands annually.

Tuberculosis offers another illustration in which many complicating factors have made its control a sociologic and economic rather than an exclusively medical question. We can preach and teach all we want about the importance of fresh air, sunshine, good food, rest and recreation, but until justice takes the place of charity, many of these things will remain beyond the ability of most men to purchase. The rich man can determine his hours of work and play, can travel in quest of change and climate, can afford nourishing food, well cooked, and can readily obtain many other hygienic necessities that were formerly regarded as luxuries. The poor man must accept conditions much as he finds them, and if overwrought and underpaid he cannot effectively guard against tuberculosis. In this sense the rich man can purchase health and life itself, and in this sense

tuberculosis and also infant mortality have become class diseases. Science has pointed the way; it remains for society to apply the remedy.

It has been made plain that it is going to take a long time to greatly diminish the prevalence of tuberculosis and other infections. Patience, therefore, is one of the virtues that the health officer must possess and teach.

#### TRAINED LEADERSHIP.

Health administration in this country lags largely for want of trained leadership. The call to public health is loud and clear. Preventive medicine is the watchword of the hour, and the people are asking, "If disease is preventable, why is it not prevented?" They are not satisfied with promises, but demand results; this is as it should be. It is now recognized that the orthodox training leading to the degree of M.D. does not necessarily fit a man for the position of health officer. The average practitioner learns little concerning vital statistics, sanitary engineering, water purification, sewage disposal, disinfection, forensic medicine, and the making and breaking of health laws. The public health officer looks upon disease in the large, and is less interested in the individual case, which is the chief concern of the practicing physician. The health officer looks upon disease with an eye to preventing its spread—in order to do so he must know its mode of transmission. The practicing physician, on the other hand, looks upon disease with a view to affording relief or cure, and his principal interest, therefore, is in diagnosis and treatment. The public health officer must also be a specialist. Public health administration is, indeed, a profession which bends its knee to none, so far as ideals and service are concerned.

The administration of public health matters has sometimes failed or has been in large degree unprofitable by reason of being out of balance with other problems that press in upon the community life. Technical features are sometimes allowed to overshadow or obscure the essential humanitarian motives. A well-developed sense of values, and the right kind of attitude toward the common welfare

are quite as essential in the equipment of a health officer as technical knowledge and ability.

It must not be understood that the health officer is concerned only with stamping out the communicable diseases. There are many preventable defects which may be reached, especially in school children, and there is the general conduct of life which makes not only for longevity but for maximum efficiency. The present-day health officer must also concern himself with the problems of heredity and eugenics. He must further concern himself with questions of immunity, and must make every effort to help the conditions which menace work-people. Industrial hygiene and the diseases of occupation form a large and important chapter in the volume of preventive medicine. Furthermore, the people must depend upon the health officer to guard the quality of the food, including the purity of the milk, and the cleanliness of the water which they consume. The health officer must, therefore, be familiar with the sanitary sciences in addition to the medical sciences, both of which, in the broad biological sense, underlie the foundation of successful health administration.

In order to meet this demand for trained leadership, Harvard University and the Massachusetts Institute of Technology have established a School for Health Officers. Other universities, notably Pennsylvania, Wisconsin, and Michigan have likewise established courses to train men to officer the public health army.

Politics have been the curse of health administration in this country. Politics and sanitation do not mix. It is important to divorce the two. Only those should be appointed to the position of health officer whose training adequately prepares them for the work. Such persons should be given compensation commensurate with their great responsibility, and the tenure of office and other conditions should be attractive so as to induce competent men to enter and build up the profession.

It is pleasurable enough to recount the progress of the sanitary sciences, but amid all the great achievements we are not blind to the fact that many problems remain un-



solved. Cancer and pneumonia still defy us—for how long who can say?—for many workers in many workshops are attacking these and other pathological puzzles with unremitting zeal. That they will be solved, and solved by the experimental method, is the firm conviction of those who are on the firing line.

The power we now possess to diminish or even conquer some of the communicable diseases has entirely overshadowed the importance of the non-communicable affections. It is quite as important to guard against organic disease of the heart, kidney, liver or brain as it is to guard against typhoid fever, tuberculosis, or smallpox. Furthermore, the object of preventive medicine is not alone to prevent infection or the premature occurrence of the degenerations which inevitably come with advancing years, but seeks to give each individual the maximum daily efficiency during his allotted lifetime. It is perhaps even more important to live efficiently than to live long. He who does nothing all his days but care for his body so as to prolong his life may neglect many material obligations and moral responsibilities. Therefore eugenics has become an integral part of the program of preventive medicine. In brief, the object of preventive medicine is not alone to live longer, for it serves little purpose to live longer if, at the same time, we cannot live healthier, happier and better lives.

In reviewing the successes of science we are not blinded by the glare of its glories. The progress has been satisfying, even brilliant, but only the surface has been scratched; our ignorance of life and its laws remains abysmal. A clear knowledge of what we do not know is quite as important as a knowledge of what we do know. Formerly it took a bold man to peep into the darkness; now many a Columbus sails the uncharted seas with undaunted spirit, hoping to find a new continent, even though only searching a new route.

The limitations of the human mind, as well as the delinquencies and defects of the human body, are brakes upon the wheels of progress.

The student of preventive medicine frankly faces the fact that the mass of mankind is diseased, ignorant, and unmoral. He has dedicated himself to the task of helping to cleanse, teach, and regenerate.

Preventive medicine dreams of a time when there shall be enough for all, and every man shall bear his share of labor in accordance with his ability, and every man shall possess sufficient for the needs of his body and the demands of health.\* These things he shall have as a matter of justice and not of charity. Preventive medicine dreams of a time when there shall be no unnecessary suffering and no premature deaths; when the welfare of the people shall be our highest concern; when humanity and mercy shall replace greed and selfishness; and it dreams that all these things will be accomplished through the wisdom of man. Preventive medicine dreams of these things, not with the hope that we, individually, may participate in them, but with the joy that we may aid in their coming to those who shall live after us. When young men have visions the dreams of old men come true.

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\* These concluding sentences are paraphrased from Victor C. Vaughan's admirable address on the "Philosophy of a Scientist," *Science*, Aug. 23, 1912, N. S. Vol. xxxvi, No 921, p. 225.



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Author

Rosenau, M. J.

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